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Anterior cruciate ligament reconstruction with use of hamstring autograft in patients with generalized ligamentous laxity

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Abstract
Background: Patients with generalized ligamentous laxity has greater risk of instability compared with a conventionally reconstructed anterior cruciate ligament injury. The purpose of this study was to evaluate the outcome of Anterior Cruciate Ligament (ACL) Reconstruction in Patients with Generalized Ligamentous Laxity.
Methods: The records of 40 patients who underwent anterior cruciate ligament reconstruction between January 2018 and June 2020 were evaluated. The patients underwent quadruple hamstring autograft reconstruction of ACL. Clinical outcomes were determined from data obtained before surgery and at the twenty-four-month follow-up visit.
Results: Postoperatively, the mean of anterior tibial translation was measured by physical examination and was found that 4 patients had grade 1 plus lachman test (p value=0.032), while no patient had grade 1 plus pivot shift test (p value=0.091). The mean score on the hospital for special surgery knee ligament questionnaire was 90.8 and mean lysholm score was 84.1.
Conclusions: On the basis of the evaluation of ligamentous laxity measured with the physical examination, anterior cruciate ligament reconstruction with use of hamstring autograft provided some anterior translation.

Keywords: Anterior cruciate ligament (ACL), generalized ligamentous laxity, lachman test

Introduction
An element of total joint flexibility that is genetically determined is generalized ligamentous laxity.
The frequency of ligamentous laxity is greater in females and ranges from 5% to 20% in the general population [1]. Recent research has shown that people with generalized ligamentous laxity are not only more likely to have anterior cruciate ligament injuries, but also do poorly in reconstructive procedures. A cautious approach should be used while doing an anterior cruciate ligament restoration on individuals with widespread laxity because of the condition's greater failure probability and complicated problems [1]. Finding the risk variables for both the injury and the postoperative prognosis in this cohort is equally essential. The accurate screening of people for generalized ligamentous laxity requires a criteria that covers all the related elements. It might be difficult to choose the right graft for anterior cruciate repair in individuals with ligament elasticity [1]. Planning ahead and paying close attention to each phase, from the clinical evaluation through the postoperative therapy, can improve outcomes following an anterior cruciate ligament restoration.
The phrase "generalized ligamentous laxity" refers to a range of motion (ROM) that is typically greater than the mean ROM of the general population. The degree to which the restraining ligaments are tight or loose determines the range of motion (ROM) that a joint is capable of sports like gymnastics that demand strong flexibility, joint laxity may be advantageous. In contrast, it could be risky in several other sports [2].

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The likelihood of knee ligament damage has been linked to excessive laxity [3-5], and it is well-acknowledged that GJL and knee hyperextension are significant risk factors for anterior cruciate ligament (ACL) injuries, particularly non-contact injuries [6-9]. For the restoration of the anterior cruciate ligament (ACL), hamstring tendon autograft continues to be a common graft option. Hamstring tendon autografts have several benefits over bone-patellar tendon-bone autografts, including less postoperative knee discomfort and a generally easier surgical recovery. This is true even if there are many other autograft and allograft choices available for ACL reconstruction. Additionally, among the greatest grafts in terms of biomechanical strength are 4-stranded (quadruple) hamstring grafts. In the current study, we sought to assess how patients with generalized ligamentous laxity responded to anterior cruciate ligament reconstruction by quadruple-strand hamstring graft.

Criteria for Assessing Generalized Ligamentous Laxity

There is no consensus on how to define this entity on a global scale. Carter and Wilkinson published the initial description of the GJL criteria in 1964 [10]. When both upper and lower limbs tested positive for more than three conditions. The approach outlined by Carter and Wilkinson in 1969 [10] was refined by Beighton and Horan [11] and updated in 1973.

1. Passive apposition of the thumb to the flexor side of the forearm.
2. Passive dorsiflexion of the little fingers beyond 90° Ability to hyperextend the elbow more than 10°.
3. Ability to hyperextend the knee more than 10°; and
4. Forward flexion of the trunk, with the knees straight, so that the palms of the hands rested easily on the floor

*A patient receives 1 point for the ability to do each of the listed actions. Generalized joint laxity is defined as a score of ≥4 points.

The Beighton-Horan index has been shown to have better concurrent validity and reproducibility than other approaches in a number of studies [9-12].

Photograph showing passive dorsiflexion of the little fingers beyond 90° & passive apposition of the thumbs to the flexor aspects of the forearms

Photograph showing the ability to hyperextend the knee more than 10°

Materials and Methods

The records of 40 patients who underwent anterior cruciate ligament reconstruction between January 2018 and June 2020 at the Department of Orthopaedic Surgery of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh were evaluated. All patients were treated by the senior author of this article. Major criteria of the selection of patients were patients with generalized ligamentous laxity which has been defined as a score of ≥4 points according to Beighton and Horan [11].

The patients were selected if they met the following criteria

1. They had a unilateral, isolated anterior cruciate ligament injury without an injury of the contra-lateral knee;
2. They had no history of surgery involving the lower extremity; and
3. They had no articular cartilage erosion of more than grade II (fissuring and fragmentation <0.5 in [13 mm] in diameter), according to the Outer bridge classification, at the time of surgery. We excluded patients with ligamentous laxity scores of <4 points according to Beighton and Horan [11].

Surgical Technique

Semitendinosus-Gracilis Autograft

For the patients undergoing reconstruction with the hamstring tendon graft, the graft was harvested through a longitudinal incision at the site of the pes anserinus insertion [15]. The Sartorius fascia was split, and the gracilis and semitendinosus tendons were harvested with a tendon stripper. The tendons were cleaned of adherent muscle fibers. A graft preparation device was used to tension the tendons, and the free ends of both tendons were sutured together with No. 2 polyester suture in a running baseball-style whipstitch. The tendons were looped over to create a quadruple graft, and the graft was sized between 7 and 8 mm. A titanium button (Endo Button, Smith and Nephew) was placed into the holder on the Graft Master and the femoral tunnel preparation, a 5.5-mm offset femoral aimer was used. The guide wire was passed through the accessory medial portal advanced completely through the femoral cortex and over-drilled by a 4.5-mm drill bit. A depth gauge was used to measure the length of this

tunnel. A closed-end femoral socket was drilled 25 mm into the femur with an additional 10 mm for the graft. For the tibial tunnel was prepared according to the method used for the patellar tendon grafts, but the size of the drill bit was selected according to the graft size The knee was cycled under graft tensioning to settle the Endo Button and to allow stress relaxation of the graft. The graft was tensioned and fixed with a biodegradable interference screw (RCI, Smith and Nephew) in the tibial tunnel with the knee 30-degree flexion.

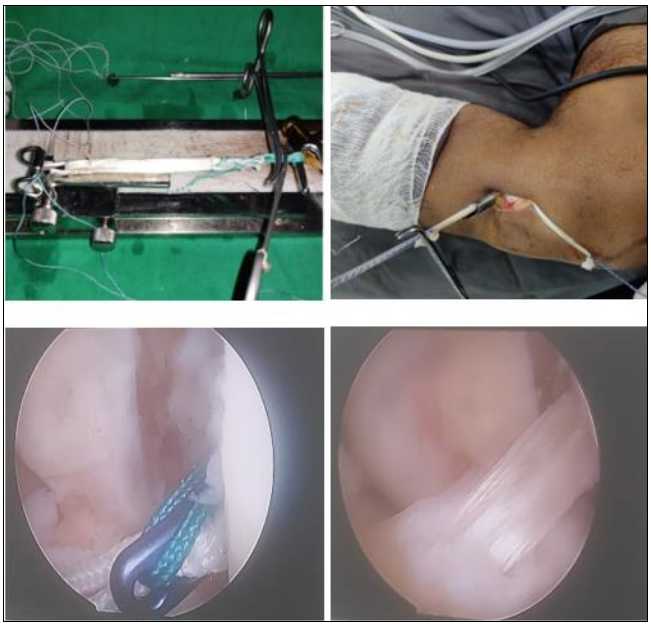

Fig 1: Operative pictures

Rehabilitation

Patients began immediate active quadriceps isometric and passive flexion exercises. Initially postoperative began with 60º Flexion then gradually increasing 15 degrees per week i.e. 90-degree flexion within the Second week & 120 degree in 1 month. Four weeks after surgery, full flexion was allowed, and patients were told to walk gradually without the brace. Full weight bearing was allowed after the fourth week as tolerated. Physical therapy started the day after surgery. Patients were allowed to run, riding a bicycle, swimming after 3 months of surgery, non-contact sports at six months and contact sports at 9 months.

Clinical Assessments

Data collected before to surgery and at the twenty-four-month follow-up visit allowed us to determine clinical outcomes. The senior author did manual exams. The Lachman and pivot-shift tests were used to evaluate the stability of the ligaments. On a scale of 0 (3 mm), I (3 to 5 mm), III (6 to 10 mm), or III (>10 mm), the Lachman test was given a grade. The tibia was rotated internally while the hip was abducted during the pivot-shift test. On a scale of 0 (absence), I (subluxation), II (jump), or III the pivot-shift phenomena were rated (transient lock). Functional result was assessed using the Lysholm knee score system and the Hospital for Special Surgery knee ligament questionnaire [5, 6, 11].

Statistical Analysis

The Hospital for Special Surgery and Lysholm ratings were compared using the Mann-Whitney test, and laxity measurements were compared using the unpaired Student t test. Using the Kolmogorov-Smirnov goodness-of-fit test to meet the student t-test's assumptions, the comparison of laxity was validated. The chi-square test was used to assess the variations between the Lachman and pivot-shift tests.The significance threshold was established at p 0.05. The mean and standard deviation of the results are provided.

Source of Funding

There was no external funding source for this investigation.

Results

There were 28 male and 12 female patients. The average age at the time of surgery was 22.4 years (range, eighteen to twenty-six years). The interval from injury to surgical treatment ranged from three to six months. With the numbers studied, no significant difference was found between sex, age at the time of surgery, and time to surgery (Table 1).

Table 1: Demographic data of the patients

Variables	Participants
No. of patients	40
Age* (years)	22.4±4.2 (18-26)
Sex (M/F)	28/12
Time to surgery* (months)	4.5±2.1 (3-6)

*The values are given as the mean and the standard deviation, with the range in parentheses

Postoperatively, the mean of anterior tibial translation was measured by physical examination and was found that 14 patients had grade 1 and 4 patients had grade 1 plus lachman test (p value=0.032), while 16 patients had grade 1 and no patient had grade 1 plus pivot shift test (p value=0.091). The mean score on the hospital for special surgery knee ligament questionnaire was 90.8 and mean lysholm score was 84.1±3.6.

Physical Examination

Preoperative Status

In the preoperative findings on physical examinations of the patients, we found that preoperative Lach-man grade or pivot-shift test (Table 2).

Table 2: Preoperative findings on physical examinations

	Grade (no. of patients)				
	0	1	2	3	P value
Lachman test	0	16	18	6	0.0476
Pivot-shift test	4	18	24	4	0.877

Postoperative Status

Table 3: Postoperative findings on physical examinations

	Grade (no. of patients)				
	0	**1**	**2**	**3**	**P value**
Lachman test	22	14	3	1	0.032
Pivot-shift test	24	16	0	0	0.091

Subjective Data

Substantial improvements in both the Hospital for Special Surgery and Lysholm scores between the preoperative and the follow-up examination were observed in both groups (Table 4), but the values were not significantly different between the groups. The postoperative mean Hospital for Special Surgery score was 90.8 points (range, 75 to 100 points) and the Lysholm score was 84.1 points (range, 72 to 99 points).

Table 4: Preoperative and postoperative functional knee scores

	Points	P value
Preoperative scores		
Hospital for special surgery	62.5±10.9	0.449
Lysholm	47.5±9.8	0.265
Postoperative scores		
Hospital for special surgery	90.8±6.7	0.592
Lysholm	84.1±3.6	0.525
*The values are given as the mean and the standard deviation		

Discussion

In individuals with widespread ligamentous laxity, this study looked at ligament stability and functional results following anterior cruciate ligament restoration. In our study there were 28 male and 12 female patients. Male majority which is similar with the previous study [15]. The average age at the time of surgery was 22.4 years (range, eighteen to twenty-six years). The interval from injury to surgical treatment ranged from three to six months. In patients undergoing anterior cruciate ligament restoration using hamstring grafts, we found Postoperatively, the mean of anterior tibial translation was measured by physical examination and was found that 14 patients had grade 1 and 4 patients had grade 1 plus lachman test (p value=0.032) which is Similar with Sung-Jae Kim *et al* Study 2010 i.e. 11 patient Grade 1 and 3 patient grade 1 plus. We found 16 patients had grade 1 and no patient had grade 1 plus pivot shift test (p value=0.091) which is similar with the previous study [14]. In our study, the mean score on the hospital for special surgery knee ligament questionnaire was 90.8 and mean lysholm score was 84.1±3.6 similar with the previous study [14] i.e. 92.1 and 91.1 respectively.

Conclusion

On the basis of the generalized ligamentous laxity in anterior cruciate ligament reconstruction with use of hamstring autograft provided some anterior translation.

Conflict of Interest

Not available

Financial Support

Not available

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